Space Weather Technical Forecast

Issued on Wednesday, 13 April 2022 at 01:26 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Increasing chance of G1/Minor Geomagnetic Storms through the period, becoming likely by Day 3 (14 Apr). Chance of Active fluence developing by Day 3.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low with a number of C-class flares over the last 24 hours. The largest of these was a C3.9 flare at 12/0649UTC from a region which is beyond the western limb. There are two sunspot regions on the disc, both in the northeastern quadrant. AR2988 (Bxo/Beta) is weak and relatively unchanging. AR2989 (Axx/Alpha) has recently rotated across the eastern limb and also appears to be benign. No Earth-directed CMEs have been observed in the last 24 hours.

Solar Wind / Geomagnetic Activity: The solar wind, as observed by DSCOVR at L1, has averaged around 450km/s due to the waning effects of coronal hole 72, which is now close to the western limb. There was a sharp increase to an average of 515km/s between 12/1000UTC and 12/1800UTC, peaking at 521km/s at 12/1514UTC. This is likely to be due to a weak CME arrival, which may be the CME which is expected early on 13 April. Density was below average, but became above average at the same time as the increase in solar wind speed, and has remained above average since. The total magnetic field strength, Bt was mainly weak until 12/1000UTC, then rising to occasional moderate levels in the presence of the suspected CME, with a peak of 8nT at 12/1204UTC. In contrast, the north-south component, Bz has varied weakly between positive and negative polarities. Phi angle was mainly negative until 12/1000UTC but has been indistinct since that time. Geomagnetic activity was initially Quiet (Kp 1-2), but has been Unsettled between 1200-2100UTC.

Energetic Particles / Solar Radiation: The high energy proton flux (10 MeV) measured at GOES-16 at GEO was at background levels. The high energy electron flux has been mainly moderate, but with a brief increase above the high (1e3pfu) level between 12/1300UTC and 12/1725UTC. The electron flux has since decreased to background levels. Electron fluence has been below the Active threshold throughout and has recently levelled out.

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Four-Day Space Weather Forecast Summary
Solar Activity: Solar activity is forecast to be mainly Very Low over the next four days, with only two benign sunspots on the visible disc.

Solar Wind / Geomagnetic Activity: The effects of a CME arrival are likely to linger into day 1 (13 April), with a further, more Earth-directed CME forecast on day 2 (14 April). Solar wind speeds are generally expected to decline through days 1 to 3, with increases to around 500km/s possible due to the forecast CME arrivals. Coronal hole 74 may then become geoeffective with the high speed stream from this feature estimated to reach speeds of around 500km/s. G1/Minor Storms are likely on day 1 and are expected on day 2, due to the CME arrivals. There is also a very slight chance of a G3/Strong Storm on day 2. Geomagnetic activity is then likely to reduce later in the period, with a slight chance of further storming on day 4, due to the connection of the positive coronal hole 74.

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux is expected to persist at background levels. The high energy electron flux (greater than 2MeV) is likely to follow a reducing trend through days 1 to 3 due to the increase in geomagnetic activity, with an increase then possible on day 4 (16 April). Electron fluence is not expected to exceed the Active threshold.

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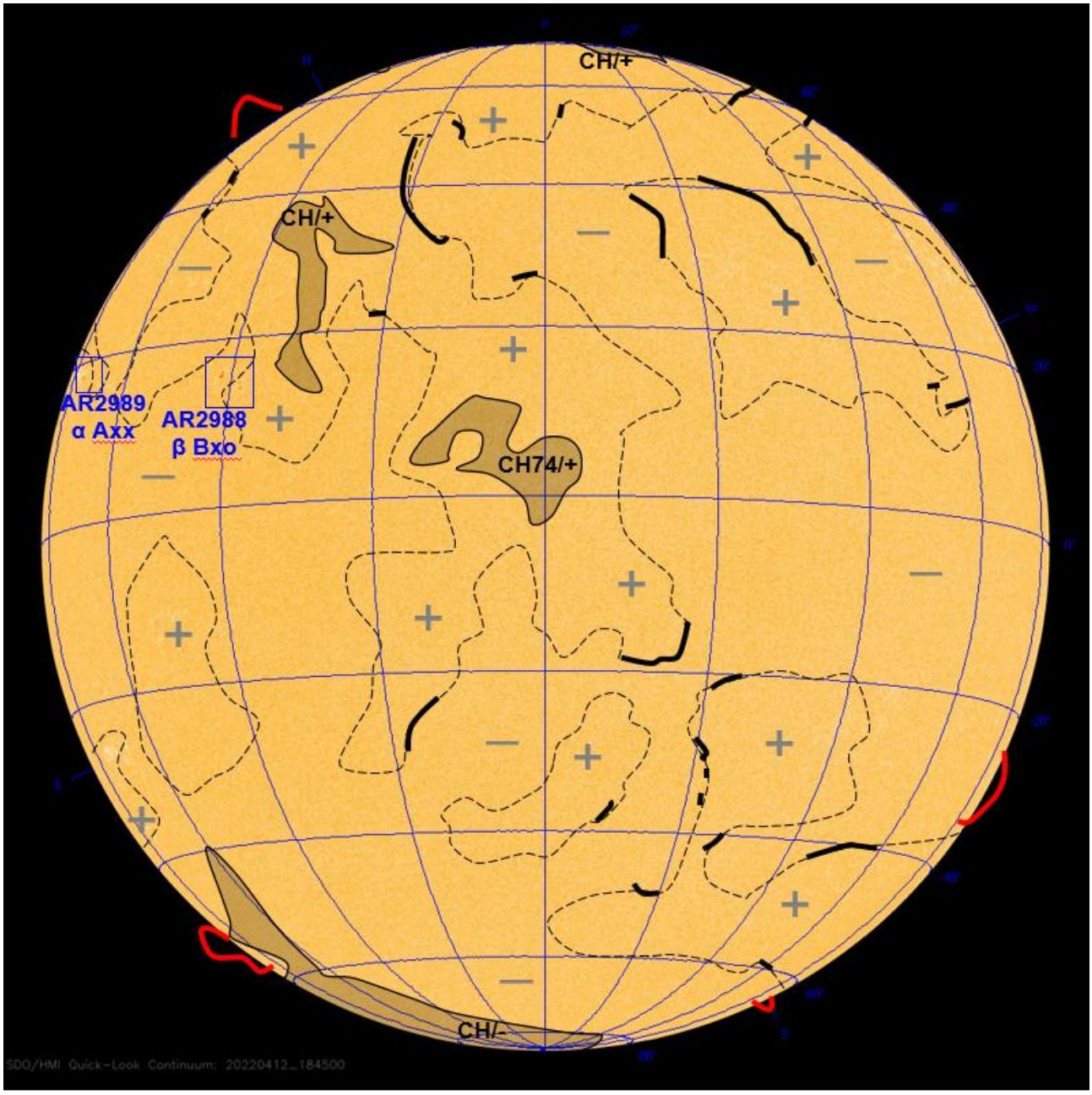
Figure 1. Solar Analysis Valid 12/2000UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

A CME from a filament eruption which left the Sun on 09 April appears to have arrived at Earth and has produced speeds of 500km/s and above average density. A further CME from a filament eruption which left the Sun on 11 April is expected to directly reach the Earth on 14 April.

The high speed stream from coronal hole 72 is waning as this coronal hole rotates across the western limb, with speeds of 450km/s. This waning is likely to be disturbed early on day 1 (13 April) due to the effects of the glancing CME which is currently affecting the Earth. The next CME on day 2 (14 April) is then likely to increase speeds to around 500-550km/s. Coronal hole 74 is then forecast to connect with the Earth on day 4 (16 April), based on an estimated speed of 500km/s. As this is a non-persistent feature and has not yet passed STEREO A, an accurate estimate of the high speed stream is not possible.

Geomagnetic activity is likely to Unsettled to Active, with a chance of G1/Minor Storms on day 1, depending on the strength of impact from the glancing CME. The Earth-directed CME on day 2 (14 April) is expected to led to G1/Minor Storms, with a residual chance of storming on day 3 (15 April). There is then a slight chance of G1/Minor Storms on day 4, dependent both on the strength of coronal hole high speed stream and how disturbed the Earth's magnetic field is from the CME impacts.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	40	70	40	20
Strong	G3	No	1	10	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
09/2010	Partial	Filament eruption	SW	500km/s	13/0100UTC	Arrival may be ongoing
11/0521	Full halo	Filament eruption	South centre disc	500km/s	14/1800UTC	G1/G2 storms expected.

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Figure 2: MOSWOC Enlil showing potential arrival time of CME which left the Sun on 11 April and is forecast to arrive at Earth on 14 April.

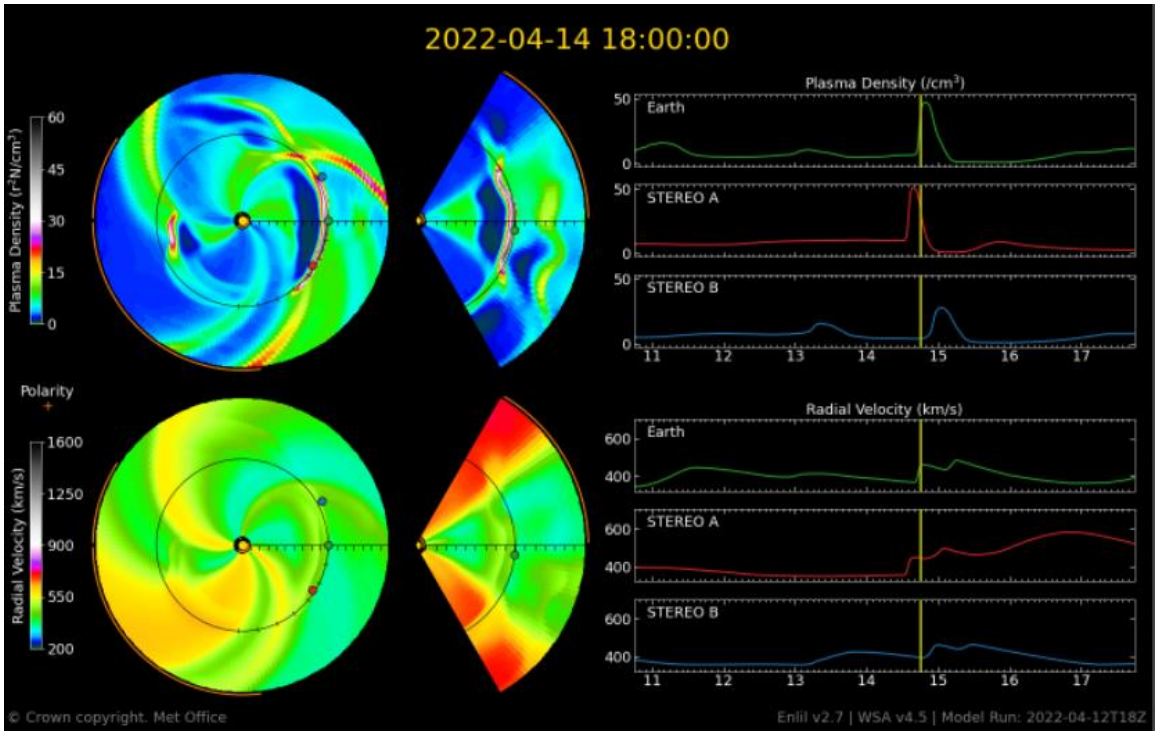

Figure 3: MOSWOC Enlil ensemble showing potential range in arrival times. The first peak is from the feature which left the Sun on 09 April, and the second peak for the CME which left the Sun on 11 April.

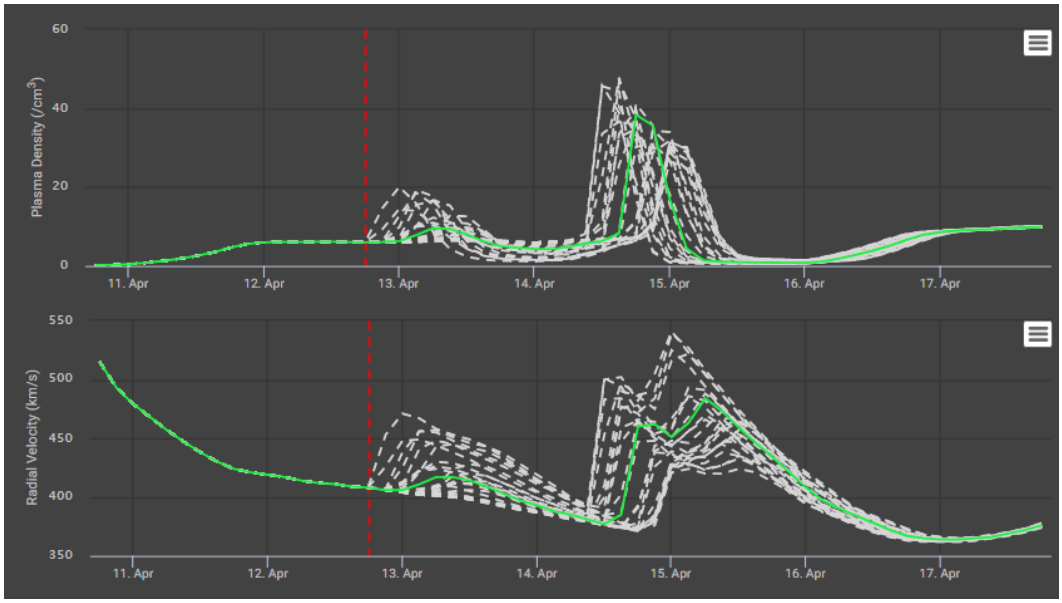

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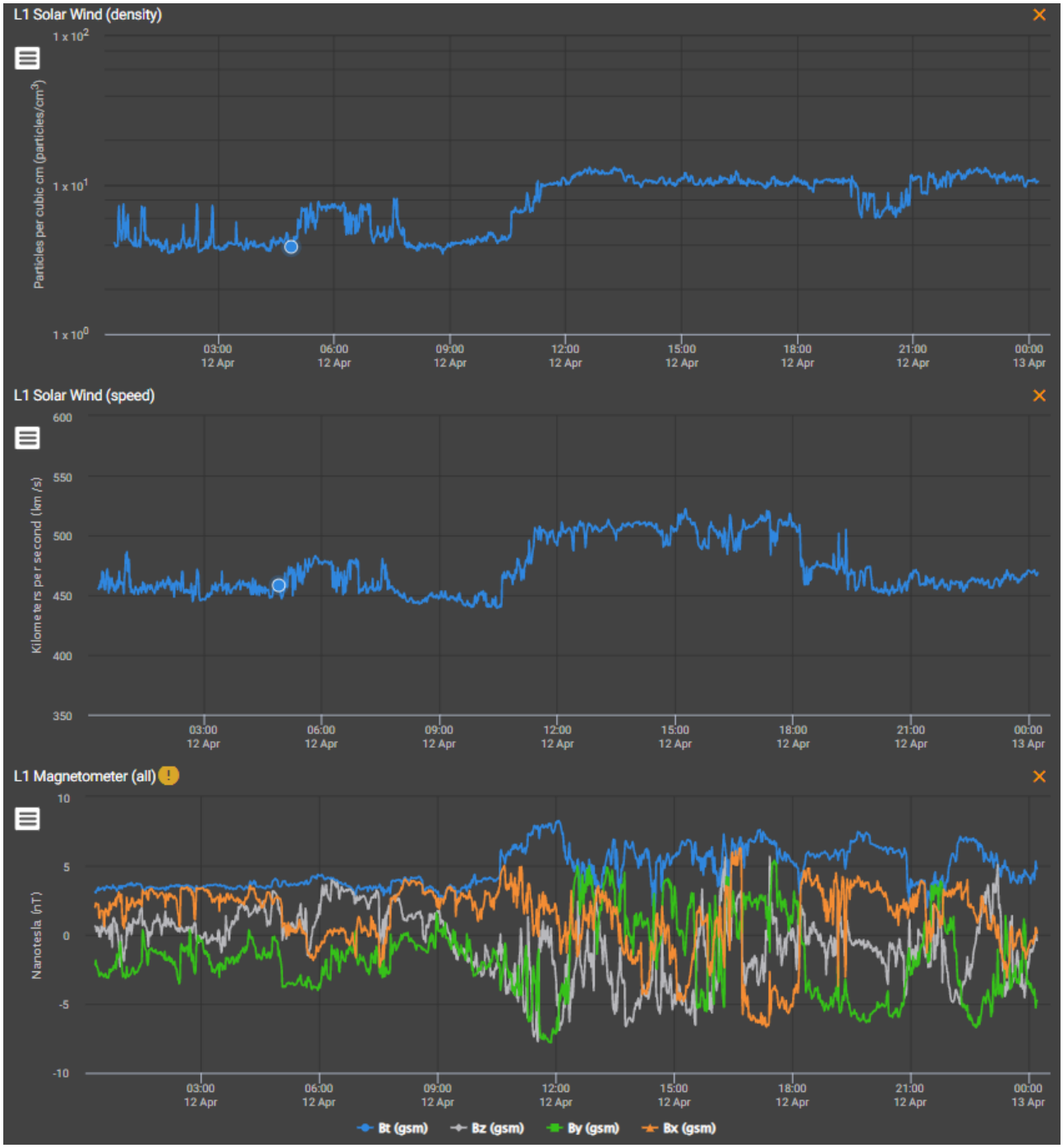
Figure 4: Recent solar wind observations from DSCOVR at L1



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Radio Blackouts - X-Ray Flares:

There are two benign sunspot regions on the visible disc in the northeastern quadrant which are assessed as a low risk of producing solar activity. The recent sources of C-class flare activity have rotated across the western limb.

Solar activity is forecast to be Very Low with no significant regions expected to develop or rotate onto the visible disc in the next 4 days. There are however a number of prominent filaments on the Earth-facing disc, which appear stable, but which could pose a risk of a CME should they erupt.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	1	1	1	1
Very Active	R3 to R5 X Class	No	1	1	1	1

Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) as measured by GOES-16 at GEO is at background and in the absence of complex sunspots on the Earth-facing disc is expected to remain at this level.

Radiation Storms	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	1	1	1	1
Very Active	≥ S3 *	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

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High Energy Electrons Event (≥ 2MeV):
The high energy electron flux (greater than 2MeV) is below the high threshold, due to recent limited Unsettled geomagnetic activity. There is uncertainty in how the electron belts will respond over the next three days. This is due to a combination of CME impacts distorting the belts and displacing electron due to heightened geomagnetic activity, contrasted with the CMEs also potentially injecting further electrons into the near Earth environment. The most likely outcome is expected to be a suppression of the electron flux on days 1 through to 3 (13 to 15 April), with a slow increase following the decrease in geomagnetic activity and onset of the coronal hole high speed stream from coronal hole 74 on day 4.

24 hour electron fluence is likely to remain below the Active (1e8 integrated pfu) level throughout due to the balance of contrasting effects. There is an increasing likelihood of the electron fluence increasing towards the Active threshold on day 4 (16 April). Due to the absence of consideration for the CMEs and relevant uncertainties, the REFM is unlikely to be of sufficient guidance.

GEO Electron Environment	Level ($cm^{-2}\ sr^{-1}\ day^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	No	10	10	10	20
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

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